

are covered entirely with sand and silt, and others are compacted with sediments or have become armored. Silt in Cottonwood Creek is derived from many sources; some of these sources are natural, but most are a result of undesirable land use practices, including timber harvesting and road-building activities on private and public land in the upper watershed. Overgrazing, wildfires, extensive land clearing in the foothill and valley areas, and discharges of decomposed granite from Rainbow Dam are also sources of sediment.

Streamflow, coarse sediment supply, and stream meander are closely linked. Together, these processes support and promote the regeneration of healthy riparian and riverine plant communities. Important restoration components include protecting the floodplain and existing stream meander characteristics of Cottonwood Creek.

Important functions of the upper watershed of Cottonwood Creek are to moderate streamflows resulting from storm events and to provide high quality water to the Sacramento River and Delta. Erosion from timber harvest, road building, and the adverse affects of grazing practices diminish the watershed's ability to moderate flows and provide high quality water. The potential for catastrophic wildfire can be reduced by fuel management programs.

Cottonwood Creek has an extensive riparian and riverine aquatic plant community that can be enhanced by improved land management and maintenance of natural sediment supply. Denuded areas need an opportunity to regenerate, and existing riparian forest needs protection.

Water conveyance structures in the lower sections of Cottonwood Creek impair the upstream passage of

adult chinook salmon and steelhead. Restoring natural sediment supply can alleviate these problems over time and permit unobstructed access to important aquatic habitats.

Extensive gravel mining in Cottonwood Creek has damaged spawning habitat and significantly reduced gravel recruitment to the Sacramento River. In addition, gravel mining creates passage and stranding problems for fish by allowing the creek to spread over the large extraction area.

During spring, low flows and high water temperatures may impede or prevent the upstream migration of adult spring-run chinook salmon to summer holding areas.

The Cottonwood Creek Ecological Management Zone includes two ecological management units: the Upper Cottonwood Creek Ecological Management Unit and the Lower Cottonwood Creek Fan Ecological Management Unit.

LIST OF SPECIES TO BENEFIT FROM RESTORATION ACTIONS IN THE COTTONWOOD CREEK ECOLOGICAL MANAGEMENT ZONE

- chinook salmon
- steelhead trout
- lamprey
- native anuran amphibians
- native resident fishes
- neotropical migratory birds
- plants and plant communities.

DESCRIPTIONS OF ECOLOGICAL MANAGEMENT UNITS

UPPER COTTONWOOD CREEK

The Upper Cottonwood Creek Ecological Management Unit provides the streamflow and coarse sediments needed to maintain the overall ecological health of lower Cottonwood Creek and the Sacramento River. Important stream reaches in the Upper Cottonwood Creek Ecological Management Unit include the South and North Forks of Cottonwood Creek, Beegum Creek, and the mainstem reach of Cottonwood Creek above the confluence with the

South Fork. The Upper Cottonwood Creek Ecological Management Unit can sustain important migration, holding, spawning, rearing, and emigration habitats for fish and wildlife species if streamflows are maintained and watersheds are rehabilitated.

The South Fork of Cottonwood Creek contains good to outstanding riparian vegetation in the foothills and lower stretches. Spring-run chinook salmon and steelhead trout can migrate to the headwaters of the South Fork, using Maple Gulch as their principal holding area. The length of the stream system below natural fish barriers is 130 linear miles, which includes the three main forks of the creek and Beegum Creek.

Spring-run chinook salmon enter Cottonwood Creek and migrate to the headwaters of the South and Middle Forks during April, May, and June. The two principal holding areas are the South Fork above Maple Gulch and Beegum Creek, a tributary to the Middle Fork. During spring of drier years, low flows and high water temperatures may impede or prevent the upstream migration of adult spring-run salmon to summer holding areas. There are no recent estimates of spring-run chinook populations; however, historic runs averaged approximately 500 salmon.

Steelhead trout enter Cottonwood Creek during late fall and early winter and spawn during winter and spring. The upper reaches of the Middle Fork, Beegum Creek, and the South Fork provide spawning and nursery areas. There are no recent estimates of steelhead populations for Cottonwood Creek. The creek also supports resident rainbow trout and brown trout in the upper tributaries.

LOWER COTTONWOOD CREEK

The Lower Cottonwood Creek Ecological Management Zone can provide important spawning areas for fall- and late-fall-run chinook salmon. Gravel transport through lower Cottonwood Creek is a significant ecological function and sufficient streamflows are needed to provide sediment transport and gravel cleansing. A long-term effort will be implemented to restore and maintain plant communities along the creek.

Salmon spawning areas in the lower reaches of Cottonwood Creek have been degraded. Some areas are entirely covered with sand and silt, and others are compacted with sediments or have become armored

during floodflows. Sedimentation binds the gravel together, which prevents salmon from creating redds (salmon spawning nests); it also reduces intergravel oxygen transport, so eggs deposited in the gravel do not survive. Armoring results when gravel is washed away during floods, leaving rocks and boulders too large for salmon to move during spawning.

Gravel has been mined in the lower Cottonwood Creek fan for many years. Gravel extraction damages spawning areas in the creek and reduces the recruitment of spawning gravel to the Sacramento River. Two major instream gravel extraction projects operate in Cottonwood Creek below the Interstate 5 bridge.

VISIONS FOR THE ECOLOGICAL MANAGEMENT ZONE AND UNITS

The vision for the Cottonwood Creek Ecological Management Zone is to restore natural streamflow patterns, coarse sediment supply, natural floodplain and flood processes, and riparian forest and riverine aquatic habitats. In addition, the proposed restoration actions are designed to reduce or eliminate to the extent necessary stressors that impair ecological processes, including gravel mining operations, structures that inhibit chinook salmon and steelhead trout migrations, and land use activities (e.g., water diversions, logging, and grazing).

A restored Cottonwood Creek will provide incremental benefits to the overall objective of restoring and maintaining important aquatic species, such as chinook salmon and steelhead trout, in Cottonwood Creek and in the Sacramento River. With restoration, Cottonwood Creek Ecological Management Zone will support sustainable populations of fall-, late-fall-, and spring-run chinook salmon and steelhead trout after natural sediment supply and gravel recruitment, cleansing, and transport processes are reactivated; gravel spawning and riparian habitats are restored; and the adverse effects of upper watershed diversions, logging, and grazing are reduced.

VISION FOR UPPER COTTONWOOD CREEK

The vision for the Upper Cottonwood Creek Ecological Management Zone is to maintain coarse sediment recruitment, cleansing, and transport; improve habitat

for chinook salmon, steelhead trout, and other native fishes; improve habitat corridors for wildlife populations; and restore riparian and riverine plant communities through improved land use and forest management practices.

The Cottonwood Creek watershed is a high-value area, both because it is a distinct Ecological Management Zone and because of its linkage with the Sacramento River Ecological Management Zone. Restoring and maintaining ecological processes and functions related to streamflow, sediment supply, gravel recruitment, cleansing, and transport, and the creation and maintenance of habitats can best be achieved by developing and implementing a local watershed management plan. The creation of a watershed management plan by the recently formed Cottonwood Creek Watershed Group is necessary. This planning effort would evaluate and develop recommendations for timber harvesting, land use, fire and fire suppression, and the management of oak woodland habitats to reduce erosion, maintain riparian zones, and provide for more sustained runoff patterns.

VISION FOR LOWER COTTONWOOD CREEK

The vision for the Lower Cottonwood Creek Ecological Management Zone is to restore, reactivate, and maintain coarse sediment supply, floodplain and flood processes, gravel recruitment, and stream meander. The vision also includes reducing stressors on these processes, including gravel mining activities in the Cottonwood Creek stream corridor.

Instream gravel extraction should be managed to protect salmon spawning and rearing habitat within Cottonwood Creek and to maintain and enhance sediment supply to the Sacramento River. Implementing such management would result in immediate benefits to salmon in Cottonwood Creek and the Sacramento River. Spawning gravel is a finite resource in the Sacramento River system, and Cottonwood Creek contains one of the most important reserves.

VISIONS FOR ECOLOGICAL PROCESSES

CENTRAL VALLEY STREAMFLOWS: Streamflows shape the stream channels, support

riparian vegetation, and transport nutrients and sediments. The vision for streamflows in Cottonwood Creek is to emulate the natural runoff pattern with a late-summer or early fall flow event.

COARSE SEDIMENT SUPPLY: Coarse sediments are abundant in Cottonwood Creek; however, gravel recruitment has diminished because of extensive mining activities. The vision is that restoring natural gravel recruitment and sediment transport processes will contribute to maintaining important habitat substrates and ecological processes in Cottonwood Creek and the Sacramento River.

STREAM MEANDER: In unimpaired systems, streams meander within their historic floodplains. This meander contributes sediments for transport and deposition, rejuvenates riparian succession, and creates new habitats for fish and other aquatic species. The vision is that a natural stream meander process will provide much of the habitat needed to support healthy riparian systems, wildlife, and aquatic species.

NATURAL FLOODPLAIN AND FLOOD PROCESSES: Coarse sediment supply, stream meander, and floodplain and flood processes are closely interrelated. The vision is that all three of these processes will moderate channel incision and scour by providing areas for bank overflow, contribute to species diversity by creating landforms that support different community structure, provide low-velocity refuge for fish and other aquatic organisms during floods.

VISIONS FOR HABITATS

RIPARIAN AND RIVERINE AQUATIC HABITATS: Health riparian habitat provides a migratory corridor for terrestrial species that connects low and higher elevation habitats. Shaded riverine aquatic habitat provides shade, contributes to moderating stream temperatures, and provides woody debris, which juvenile fish use as escape and resting cover. The vision is that Cottonwood Creek will support healthy riparian, shaded riverine aquatic and woody debris habitats, which in turn will support improved survival of aquatic and terrestrial species.

FRESHWATER FISH HABITAT: Freshwater fish habitat is an important component needed to ensure the sustainability of resident native and anadromous fish species. Upper Cottonwood Creek is typical of a

salmon-steelhead stream and lower Cottonwood Creek is typical of a fall chinook salmon spawning stream (Moyle and Ellison 1991). The vision is to maintain the quality of freshwater fish habitat in Cottonwood Creek through actions directed at streamflows, coarse sediment supply, stream meander, natural floodplain and flood processes, and maintaining and restoring riparian and riverine aquatic habitats.

ESSENTIAL FISH HABITAT: Cottonwood Creek has been identified as Essential Fish Habitat (EFH) based on the definition of waters currently or historically accessible to salmon (National Marine Fisheries Service 1998). The vision is to maintain or restore EFH in Cottonwood Creek including substrate composition; water quality; water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity; space; access and passage; and flood plain and habitat connectivity.

VISION FOR REDUCING OR ELIMINATING STRESSORS

GRAVEL MINING: Coarse sediment supply in Cottonwood Creek is adversely affected by gravel mining. This lack of instream sediments affects stream channel morphology, stream meander, and riparian systems. The vision for Cottonwood Creek is that gravel mining activities will be relocated to areas outside the active stream channel.

VISIONS FOR SPECIES

CHINOOK SALMON: The vision for Central Valley chinook salmon is to recover all stocks presently listed or proposed for listing under ESA and CESA, achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that use fully existing and restored habitats. The fall-, spring-, and late-fall-runs of chinook salmon depend on Cottonwood Creek's streamflow, natural sediment supply, and riverine aquatic habitats. The vision is that Cottonwood Creek will provide for sustainable chinook salmon populations.

STEELHEAD: The vision for steelhead is to recover this species listed as threatened under ESA. Steelhead use Cottonwood Creek and will benefit from many of the actions that will improve conditions for chinook

salmon. The vision is that Cottonwood Creek will support a sustainable steelhead population.

LAMPREY: The vision for lamprey is to maintain and restore population distribution and abundance to higher levels than at present. The vision is also to understand life history and factors in Cottonwood Creek better which influence abundance. Lamprey are a California species of special concern. Because of limited information regarding their status, distribution, and abundance, the vision is that additional monitoring or research will provide the data necessary to manage these species and their habitat better.

NATIVE ANURAN AMPHIBIANS: The vision for the native anuran species is to stop habitat loss and the introduction of other species that prey on the different life stages of these amphibians. Ongoing surveys to monitor known populations and find additional populations are essential to gauge the health of the species in this group. To stabilize and increase anuran populations, non-native predator species should be eliminated from historic habitat ranges. Increasing suitable habitat and maintaining clean water supplies that meet the needs of the various species in this group is essential.

NATIVE RESIDENT FISH: The vision for native resident fish species is to maintain and restore by distribution and abundance of species such as Sacramento blackfish, hardhead, tule perch, Sacramento sucker, and California roach.

NEOTROPICAL MIGRATORY BIRDS: The vision for neotropical migratory birds is to maintain and increase populations through restoring habitats on which they depend.

PLANT SPECIES AND COMMUNITIES: The vision for plant species and communities is to protect and restore these resources in conjunction with efforts to protect and restore wetland and riparian and riverine aquatic habitats.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Maintaining and restoring the ecological health of the Cottonwood Creek Ecological Management Zone and its respective Ecological Management Zones will depend primarily on cooperative endeavors to locate

alternative sources of water in the upper watershed and to eliminate gravel extraction operations in the lower creek.

WATERSHED MANAGEMENT PLANNING

Restoration of this Ecological Management Zone requires developing and implementing a comprehensive watershed management program for the upper and lower areas. Eliminating gravel extraction operations will increase the delivery of sediments to the Sacramento River, improve upstream fish passage, improve spawning habitat for chinook salmon using the lower reach, and allow for restoring a riparian corridor and a clearly defined stream channel. Improved watershed management in the upper watershed will protect streamflow, gravel sources, spawning and rearing habitat of salmon and steelhead, and wildlife habitats. The Cottonwood Creek Watershed Group is seeking to develop and implement a watershed management plan. This planning effort would assess current conditions in the watershed to provide a baseline from which to develop future projects. In addressing watershed stewardship, the Cottonwood Creek Watershed Group has recommended evaluating vegetation management, land use, fire and fuel suppression, managing oak woodlands, reducing erosion, maintaining riparian zones, and providing more sustained runoff patterns in the upper watershed area. Their proposed planning effort would seek to return to natural or near-natural ecosystem functioning, reactivate and maintain natural sediment transport processes, improve floodplain and flood processes, and protect salmon spawning and rearing habitat in the lower watershed area.

AGGREGATE RESOURCE MANAGEMENT PLAN

In attaining the vision for the Cottonwood Creek Ecological Management Zone, ERPP encourages gravel operators and the local counties cooperatively to develop and implement an aggregate resource management plan (ARMP). Potential measures in a county-wide ARMP would include recommendations or requirements for:

- limiting instream extraction to less than the sustained yield of the system while providing sediment input to the Sacramento River,

- implementing measures to prevent channel incision, such as installing stream grade control structures, and
- revegetating all permanently exposed lands that have been denuded by mining operations.

CENTRAL VALLEY PROJECT IMPROVEMENT ACT

The Central Valley Project Improvement Act (CVPIA) added "mitigation, protection and restoration of fish and wildlife" as a purpose of the Central Valley Project. It required the implementation of a program that makes all reasonable efforts to increase the natural production of anadromous fish in Central Valley rivers and streams to not less than twice the average levels present from 1967 to 1991.

The U.S. Fish and Wildlife Service (USFWS) and the Bureau of Reclamation (Reclamation) are implementing the CVPIA, which provides for restoring habitats and species and eliminating many stressors. Key elements of the CVPIA program include the Anadromous Fish Restoration Program (USFWS 1995) and the Anadromous Fish Screening Program. Other elements are directed at spawning gravel replenishment on the Sacramento River below Keswick Dam, water acquisition, and other measures that will contribute to health of the Cottonwood Creek, Sacramento River and Sacramento-San Joaquin Delta Ecological Management Zones.

SALMON, STEELHEAD TROUT AND ANADROMOUS FISHERIES PROGRAM ACT

Established in 1988 by Senate Bill 2261, this Act directs the California Department of Fish and Game (DFG) to implement measures to double the numbers of salmon and steelhead present in the Central Valley (DFG 1993, 1996). The DFG's salmon and steelhead restoration program includes cooperative efforts with local governments and private landowners to identify problem areas and to assist in obtaining funding for feasibility studies, environmental permitting, and project construction.

CALFED BAY-DELTA PROGRAM

CALFED has funded two ecosystem restoration projects in Cottonwood Creek. One project funded the

formation of a watershed group and another funded restoration of the creek channel.

LINKAGE TO OTHER ECOLOGICAL MANAGEMENT ZONES

Cottonwood Creek can support larger populations of fall-, late-fall-, and spring-run chinook salmon and steelhead trout, but there are many stressors outside the Cottonwood Creek Ecological Management Zone that impair or reduce the survival of adult and juvenile chinook and steelhead. Restoration efforts in the Sacramento River, Sacramento-San Joaquin Delta, and Suisun Marsh/San Francisco Bay Ecological Management Zones will all contribute to improved returns of adult fish.

In addition, the gravel recruitment, cleansing, and transport functions of Cottonwood Creek are critical to maintaining the long-term ecological health of the Sacramento River Ecological Management Zone and the fish, wildlife, and plant resources that it supports.

RESTORATION TARGETS AND PROGRAMMATIC ACTIONS ECOLOGICAL PROCESSES

CENTRAL VALLEY STREAMFLOWS

TARGET 1: During summer and fall, more closely emulate the seasonal streamflow pattern, so that flows are sufficient for chinook salmon holding and spawning in most year types by providing up to 20 to 50 cfs. These flows can mobilize and transport sediments, allow upstream and downstream fish passage, create point bars, and contribute to stream channel meander and riparian vegetation succession (◆).

PROGRAMMATIC ACTION 1A: Augment summer and fall flow in Cottonwood Creek by purchasing water from willing sellers and developing alternative supplies.

RATIONALE: The streams in the Cottonwood Creek Ecological Management Zone provide extremely valuable habitat for spring-run chinook salmon and steelhead trout and for fall-run chinook salmon in some years. One of the key attributes of streamflow in this Ecological Management Zone is to provide for

successful upstream passage of adult fish and fish spawning. In some years, flows are insufficient to provide fish passage or recede too quickly after fish spawn and expose or dewater redds containing incubating eggs or sac fry. In addition, flow in Cottonwood Creek is the power that drives many ecological functions and processes linked to stream channel morphology, sediment transport and gravel recruitment, riparian communities, and fish habitat.

Instream flow needs on Cottonwood Creek should be subject to focused research to determine if the proposed flow increase of 20 to 50 cfs is appropriate.

COARSE SEDIMENT SUPPLY

TARGET 1: Maintain existing levels of erosion and gravel recruitment in streams in the Cottonwood Creek Ecological Management Zone, and provide for increasing the transport of these sediments to the Sacramento River by an average of 30,000 to 40,000 tons per year (◆◆◆).

PROGRAMMATIC ACTION 1A: Cooperatively develop and implement a gravel management program for Cottonwood Creek. The program would protect and maintain important ecological processes and functions related to sediment supply, gravel recruitment, and gravel cleansing and transport. This would involve working with state and local agencies and gravel operators to protect spawning gravel and enhance recruitment of spawning gravel to the Sacramento River in the valley sections of Cottonwood Creek.

PROGRAMMATIC ACTION 1B: Cooperate with the aggregate resource industry to relocate existing gravel operations on Cottonwood Creek to areas outside of the active stream channel.

TARGET 2: Repair and rehabilitate spawning gravels in 10 to 20 miles of the lower South Fork and mainstem of Cottonwood Creek (◆◆◆).

PROGRAMMATIC ACTION 2A: In the short term, develop a cooperative program to rip and clean or reconstruct important salmon spawning riffles on the South Fork Cottonwood Creek and on lower Cottonwood Creek below the South Fork.

RATIONALE: Gravel deposits in the lower South Fork and in the mainstem below the South Fork are essential to maintaining spawning and rearing habitats

of spring-run and fall-run chinook salmon, steelhead trout, and other native fishes. Historically, Cottonwood Creek was one of the most important sources of gravel to the Sacramento River. Since Shasta Dam was completed in the 1940s, Cottonwood Creek has become the single largest contributor of coarse sediments. Improving and maintaining sediment sources and transport capabilities of this stream are essential components necessary to restore and maintain the ecological health of the Sacramento River.

Gravel transport is the process whereby flows carry away finer sediments that fill gravel interstices (i.e., spaces between cobbles). Gravel cleansing is the process whereby flows transport, grade, and scour gravel. Gravel transport and cleansing by flushing most of the fines and the movement of bedload (the load of material carried downstream in the streambed by flow) are important to maintaining the amount and distribution of spawning habitat in the Cottonwood Creek basin. Although these processes have been greatly reduced or altered as a result of human activities, they can be restored and maintained by changing water flow and sediment supplies, removing stressors, or directly manipulating channel features and stream vegetation. Gravel deposits in the lower South Fork and in the mainstem below the South Fork have been adversely affected by sedimentation from upstream sources in the watershed. Mechanical means will be used infrequently to free excessive quantities of fine sediments from the gravel substrates until upstream sources of sediment have been reduced or eliminated through watershed management and restoration.

STREAM MEANDER

TARGET 1: Preserve or restore the 50- to 100-year floodplain and existing channel meander characteristics of streams in the Cottonwood Creek Ecological Management Zone, particularly in low-gradient areas throughout the lower 20 miles where most deposition occurs and where stream channel meander is most pronounced (◆◆).

PROGRAMMATIC ACTION 1A: Cooperatively evaluate reestablishing the floodplain along the lower reach of Cottonwood Creek, and evaluate constructing setback levees to reactivate channel meander in areas presently confined by levees.

PROGRAMMATIC ACTION 1B: In the short term, develop a cooperative program to mechanically create a more defined stream channel in lower Cottonwood Creek. This would facilitate fish passage by minimizing water infiltration through the streambed and maintaining flow connectivity with the Sacramento River until natural meander returns.

RATIONALE: Stream meander belts are the area in which natural bank erosion and floodplain and sediment bar accretions occur along stream courses. Natural stream meander in Cottonwood Creek functions dynamically to transport and deposit sediments and provide transient habitats important to algae, aquatic invertebrates, and fish. Meander also creates surfaces that are colonized by natural vegetation that support wildlife. Cottonwood Creek is a nondammed tributary and a significant source of sediment to the Sacramento River. To maintain the creek's natural stream channel and fluvial dynamic processes and to provide long-term resilience for its watershed and stream channel processes in the Sacramento River, Cottonwood Creek should be fully restored and protected.

NATURAL FLOODPLAINS AND FLOOD PROCESSES

TARGET 1: Develop a cooperative program to identify opportunities to allow Cottonwood Creek seasonally to inundate its floodplain (◆◆).

PROGRAMMATIC ACTION 1A: Conduct a feasibility study to determine means by which to increase floodplain interactions on lower Cottonwood Creek.

PROGRAMMATIC ACTION 1B: Minimize adverse effects of permanent structures such as bridges on floodplain processes.

RATIONALE: Natural functioning floodplain processes on Cottonwood Creek are equally important with stream meander and natural sediment supply. A conceptual model of these interactions needs to be developed further to understand the dynamic structure of Cottonwood Creek and to allow the design and implementation of future actions to protect and restore these important ecological functions.

HABITATS

RIPIARIAN AND RIVERINE AQUATIC HABITATS

TARGET 1: Develop a cooperative program to establish a continuous 130-mile riparian habitat zone along upper and lower Cottonwood Creek and its tributaries through conservation easements, fee acquisition, or voluntary landowner measures (◆◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to establish, restore, and maintain riparian habitat on Cottonwood Creek through conservation easements, fee acquisition, or voluntary landowner cooperation.

PROGRAMMATIC ACTION 1B: Encourage the development of long-term measures in the comprehensive watershed management plan to improve water temperatures further. Develop a cooperative approach with counties and local agencies to implement land use management to protect riparian vegetation along the streams. Develop programs to restore lost riparian vegetation.

PROGRAMMATIC ACTION 1C: Cooperatively negotiate long-term agreements with local landowners to maintain and restore riparian communities along the lower reaches of Cottonwood Creek.

RATIONALE: Many species of wildlife in the Cottonwood Creek watershed depend on or are closely associated with riparian habitats. Of all the habitat types in California, riparian habitats support the greatest diversity of wildlife species. Degradation and loss of riparian habitat have substantially reduced the habitat area available for associated wildlife species. Loss of this habitat has reduced water storage, nutrient cycling, and foodweb support functions.

FRESHWATER FISH HABITAT AND ESSENTIAL FISH HABITAT

TARGET 1: Maintain and improve existing freshwater fish habitat and essential fish habitat through the integration of actions described for ecological processes, habitats, and stressor reduction or elimination (◆◆).

PROGRAMMATIC ACTIONS: No additional programmatic actions are recommended.

RATIONALE: Freshwater fish habitat and essential fish habitat are evaluated in terms of their quality and quantity. Actions described for Cottonwood Creek ecological processes, stressor reduction, and riparian and riverine aquatic habitat should suffice to maintain and restore freshwater fish habitats. For example, maintaining freshwater and essential fish habitats is governed by actions to maintain streamflow, improve coarse sediment supplies, maintain stream meander, maintain or restore connectivity of Cottonwood Creek and its floodplain, and in maintaining and restoring riparian and riverine aquatic habitats.

REDUCING OR ELIMINATING STRESSORS

DAMS AND OTHER STRUCTURES

TARGET 1: Facilitate passage of steelhead and spring-run chinook salmon to the holding, spawning, and rearing habitat in the higher elevation reaches and tributaries (◆◆).

PROGRAMMATIC ACTION 1A: Begin an evaluation of structures (such as culverts, bridge abutments, grade control structures, etc.) that may be impeding or hindering migration to the high quality upstream habitat and implement measures to facilitate upstream passage.

RATIONALE: Because Cottonwood Creek and its tributaries have no major dams, this system represents one of the best opportunities to restore steelhead and spring-run chinook salmon to the mid- to high-elevation habitats on which they depend. However, even in the absence of large impassable dams, migration of adults can be impaired by smaller structures, such as culverts and road grade control structures, that may not be complete barriers to migration but can hinder migration at low flows. Also, the cumulative effect of numerous structures can cause significant delays in migration, which can reduce survival. Restoring viable populations of steelhead and spring-run chinook to this system would contribute significantly to the over-all recovery of these fish in the Central Valley.

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◆ COLUSA BASIN ECOLOGICAL MANAGEMENT ZONE



INTRODUCTION

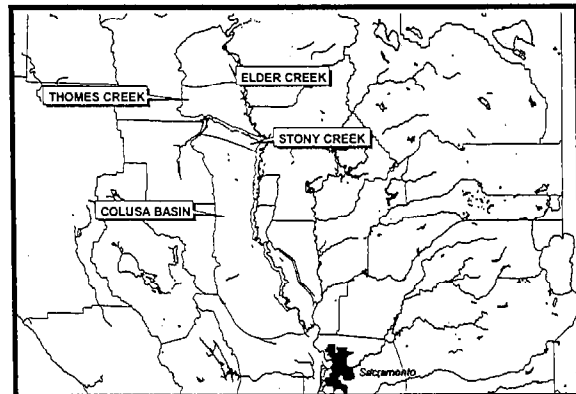
The long-term ecological health of the Delta depends on the health of its component parts. The Colusa Basin Ecological Management Zone contribution to the health of the Sacramento-San Joaquin Delta and Sacramento River Ecological Management Zones will increase after its ecological processes, habitats, and ability to support sustainable fish, wildlife, and plant communities are improved. The Colusa Basin Ecological Management Zone supports the Bay-Delta by contributing flow and sediment, and by providing riparian and riverine aquatic and wetland habitat that supports a wide variety of wildlife.

The streams in this Ecological Management Zone provide seasonally important rearing habitat for many fish species found in the Sacramento River.

The Colusa Basin Ecological Management Zone is one of the primary waterfowl and wetland migratory birds migration and wintering areas of the Pacific Flyway. The Zone contains three National Wildlife Refuges and some critical privately owned wetlands in the Sacramento Valley. The Colusa Basin Drainage area contains vital waterfowl and wetland habitats, contributes to the filtering of agricultural return flow, and has potential for riparian restoration. The wetlands along the drain provide important habitat for endangered and threatened species. The Colusa National Wildlife Refuge has some of the highest concentrations of giant garter snake in the Central Valley.

DESCRIPTION OF THE MANAGEMENT ZONE

The Colusa Basin Ecological Management Zone is an extensive hydrologic and geographic area west of the Sacramento River between Cottonwood Creek to the north and Cache Creek to the south. This zone is divided into the Stony Creek, Elder Creek, Thomes Creek, and Colusa Basin Ecological Management Units.



Location Map of the Colusa Basin Ecological Management Zone and Units.

Protecting and improving important ecological processes and functions will help to maintain important attributes of the Colusa Basin Ecological Management Zone, and preserve its ability to serve as a source of sediment and nutrients to the Sacramento River Ecological Management Zone.

Important ecological processes needed to provide a healthy ecosystem in the Colusa Basin Ecological Management Zone and contribute to the health of the Sacramento River are the streamflow patterns of the basin and natural sediment supply.

The three largest tributary streams in this zone (Stony, Elder, and Thomes creeks) all discharge into the Sacramento River. The Colusa Basin maintains some of its historic capacity to retain and detain floodwater. It captures the seasonal inflow from small westside tributaries that flow into it.

The soils underlying the Stony, Elder, and Thomes Creek watersheds are important sediment sources to the Sacramento River.